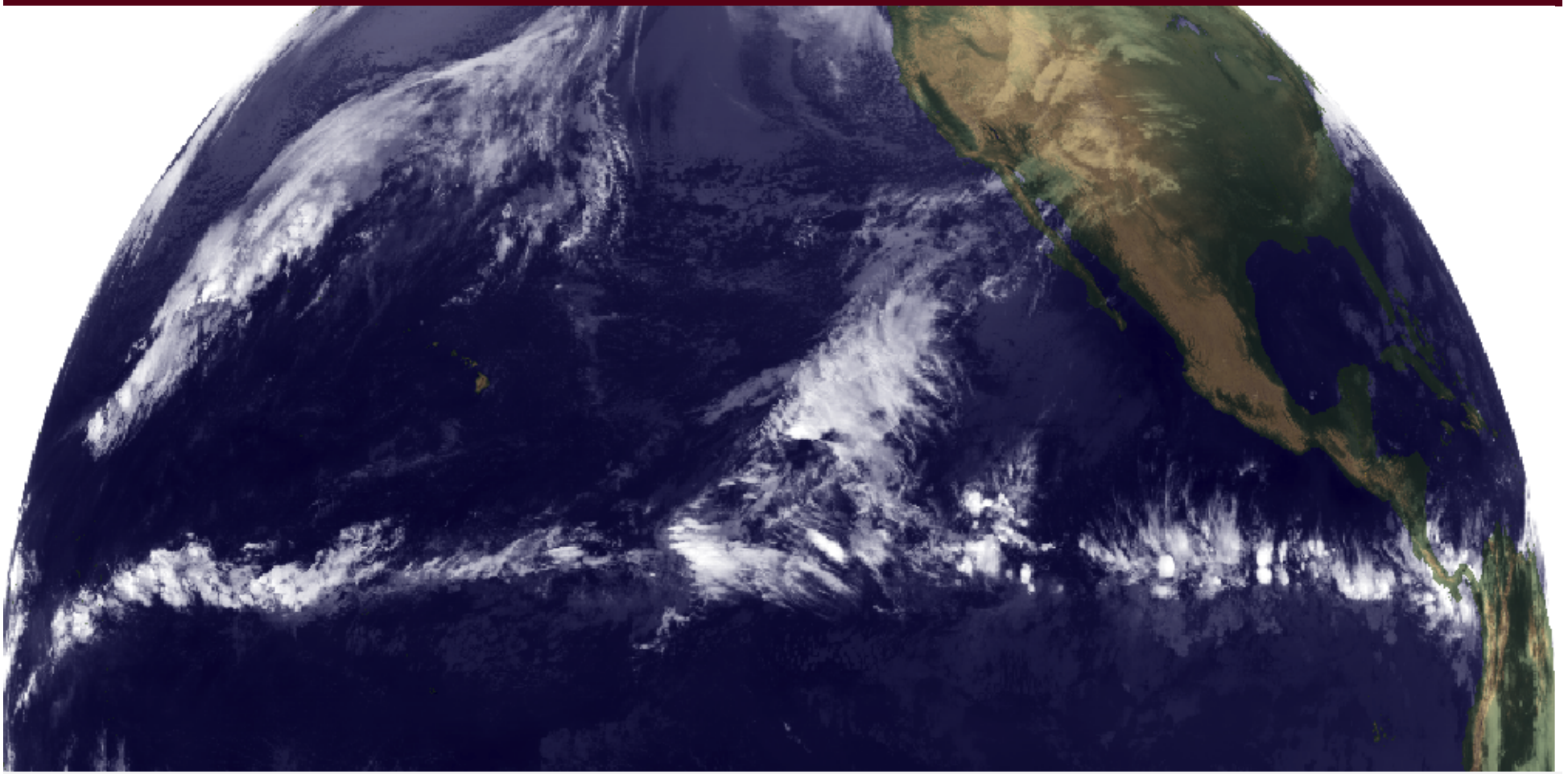


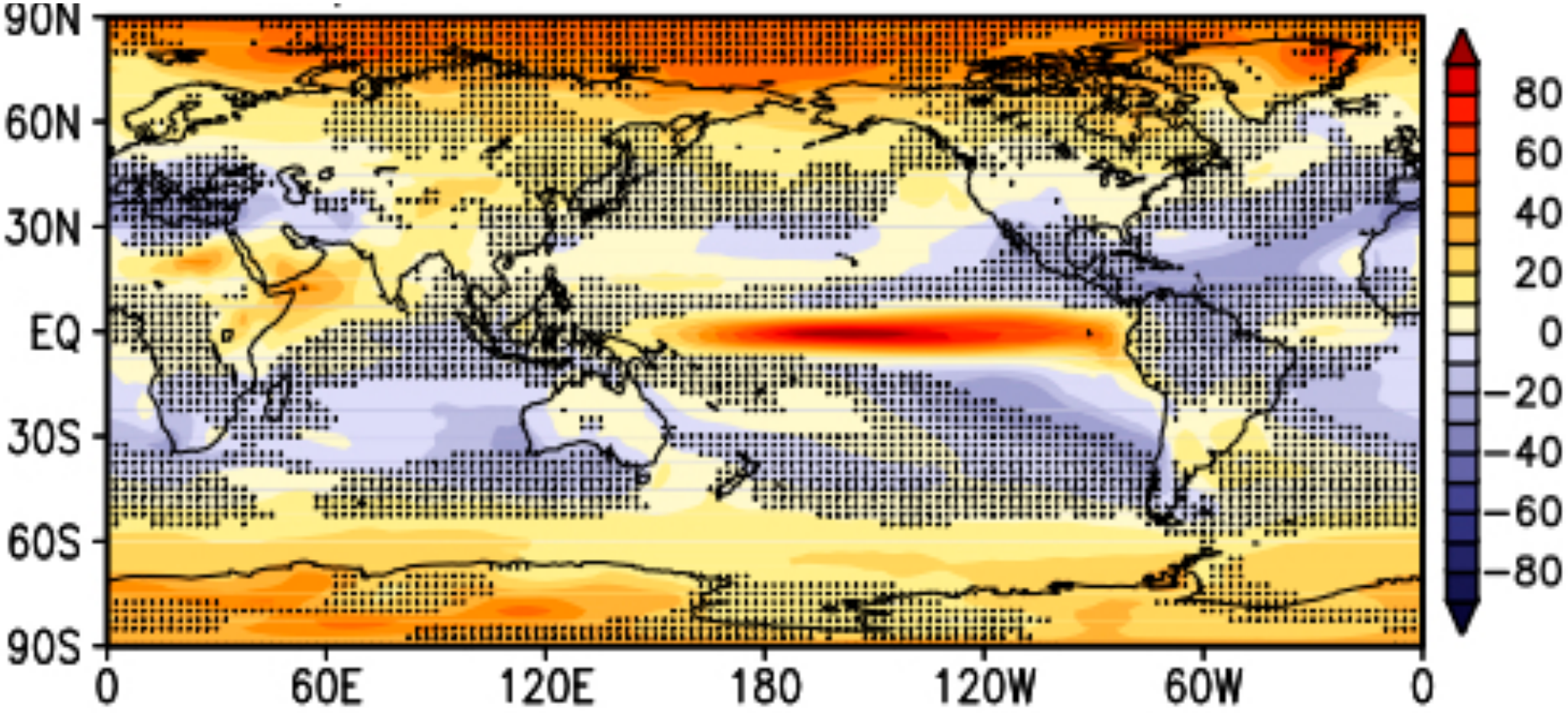
Variability in Convective Feature Populations with ITCZ Width in the Pacific

Anita D. Rapp and Kyle Wodzicki

6 November 2019

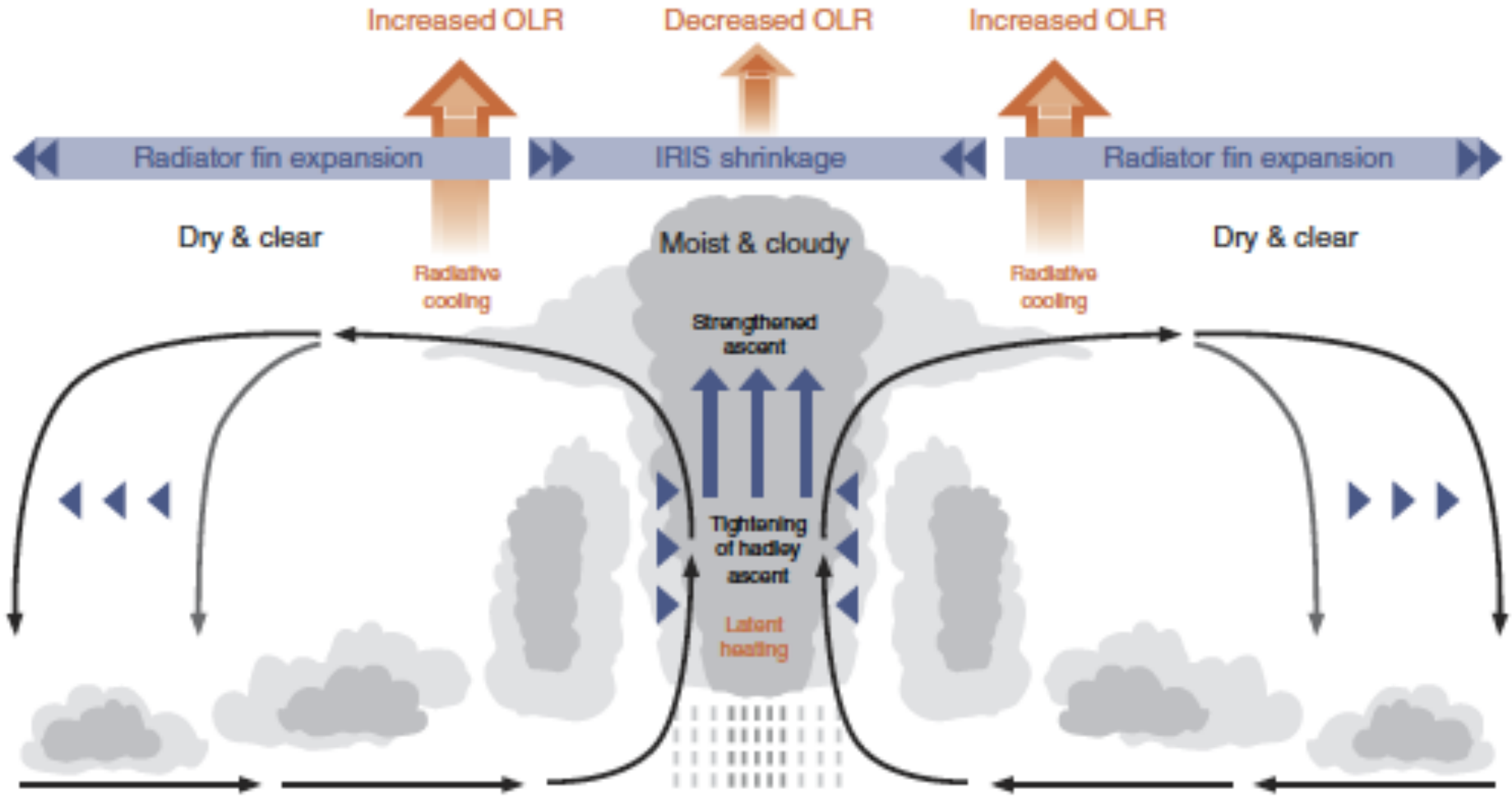
"Deep Tropics Squeeze"

Trends in GCM Precipitation



Lau and Kim 2015

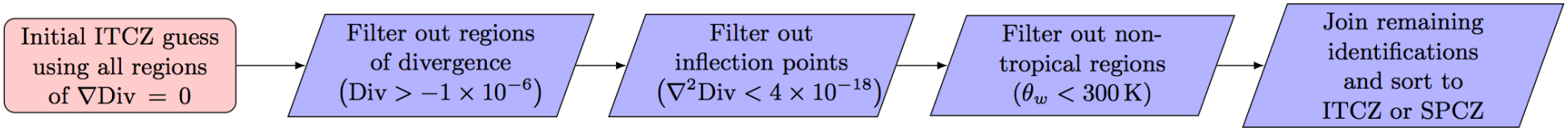
"Tightening of Hadley Ascent"



Su et al. 2017

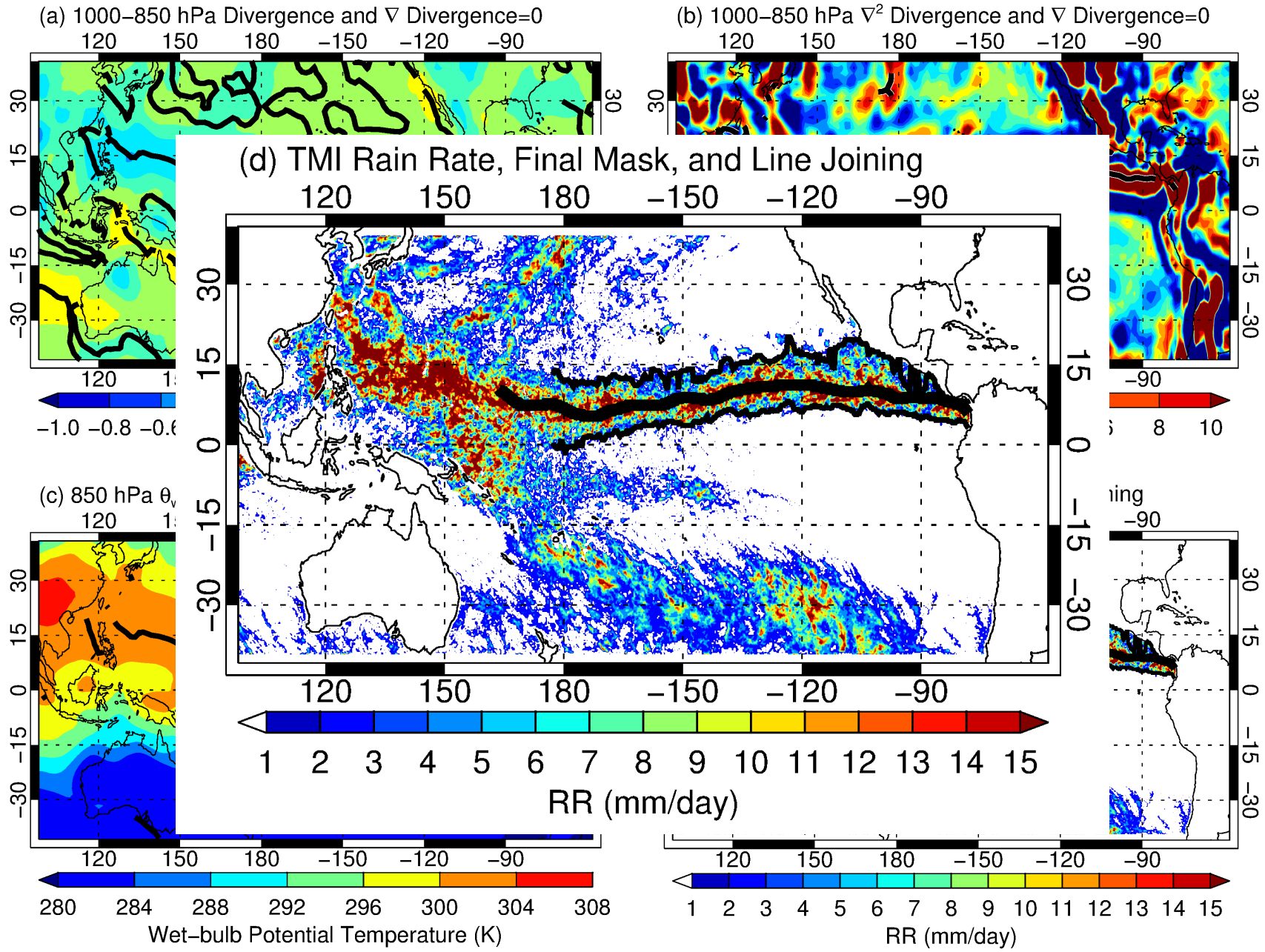
ITCZ Location, Width, Intensity Metrics

- **Modified version of Berry and Reeder (2014) identification method**
  - Apply a series of dynamic and thermodynamic masks to monthly mean ERA-Interim reanalysis
    - Divergence, ∇Divergence, ∇^2Divergence, θ_w(850)

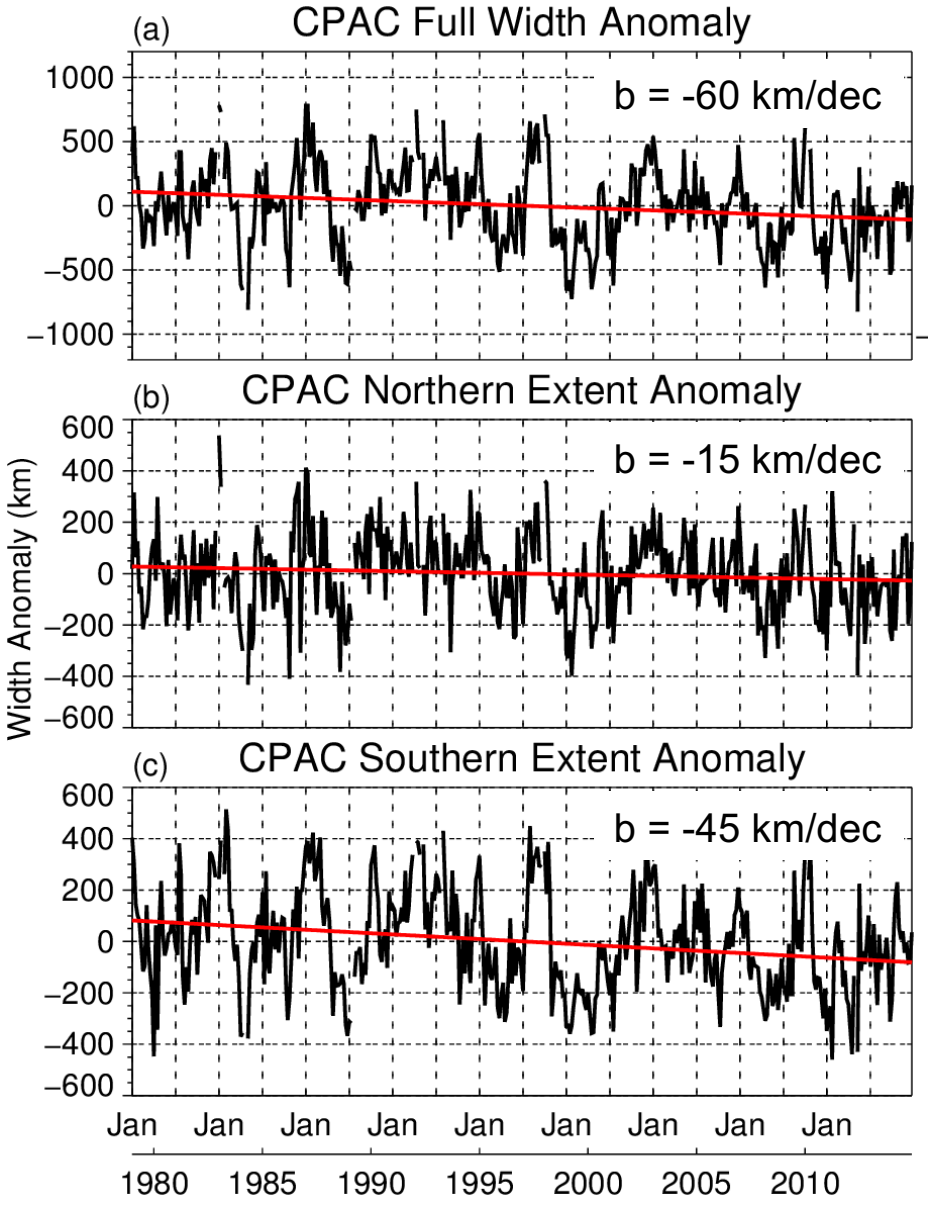


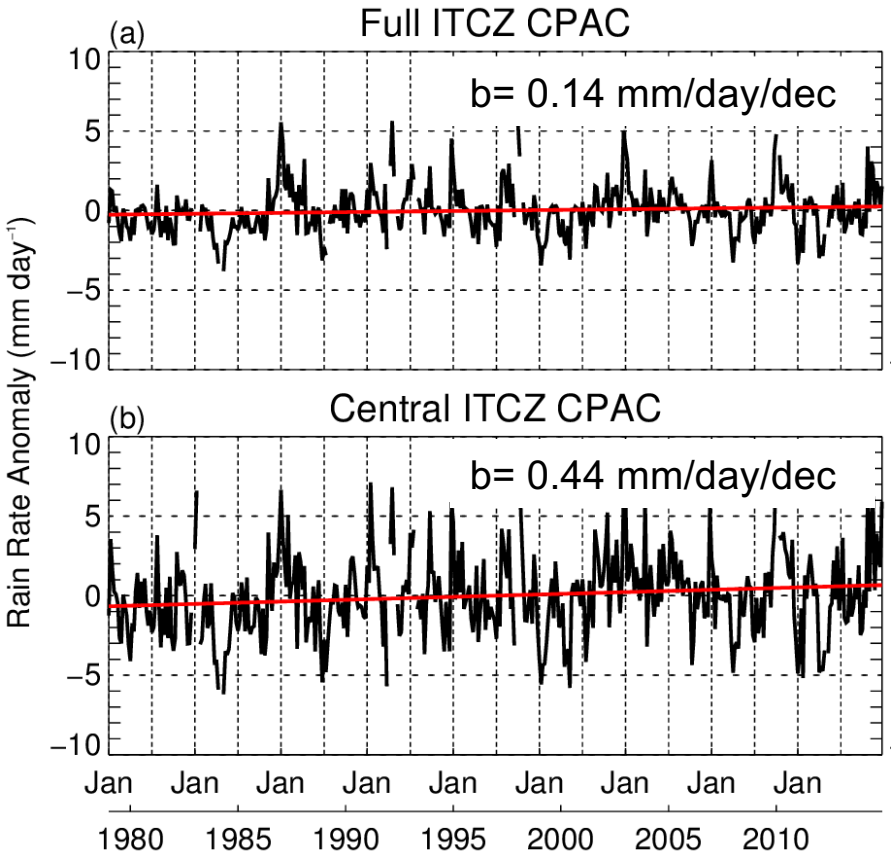
- **Use monthly mean rain rates to identify ITCZ boundaries**

ITCZ Identification Example



Long-term Pacific ITCZ Trends





From Wodzicki and Rapp (2016)
Byrne et al. (2018)
Stephens et al. (2018)

Summary

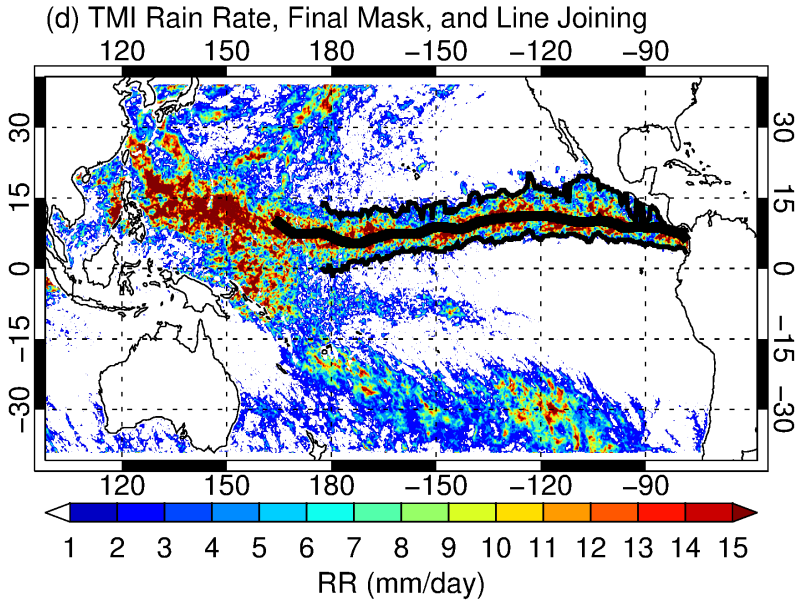
- Observations show long-term narrowing of ITCZ, especially in central Pacific
- Precipitation intensity in ITCZ center increases with narrowing
- Dry layer frequency in ITCZ region has increased, especially in region of greatest narrowing (not shown)

Current work

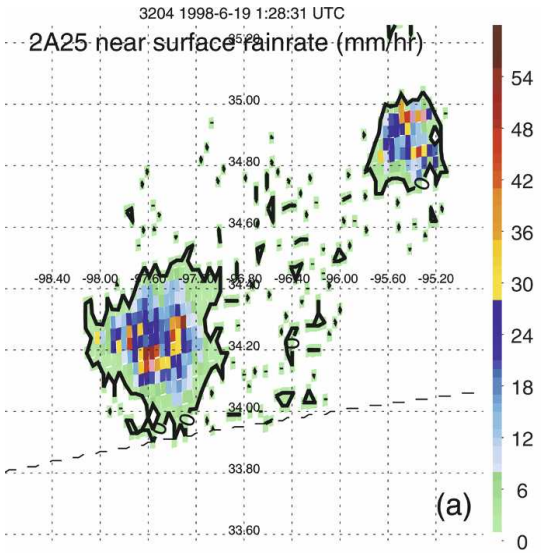
- How does the population of individual precipitating cloud systems vary with large-scale ITCZ variations?

Precipitation Features (PFs)

- **Extracted all TRMM PR PFs from Liu et al. (2008) that fall within ITCZ boundaries**

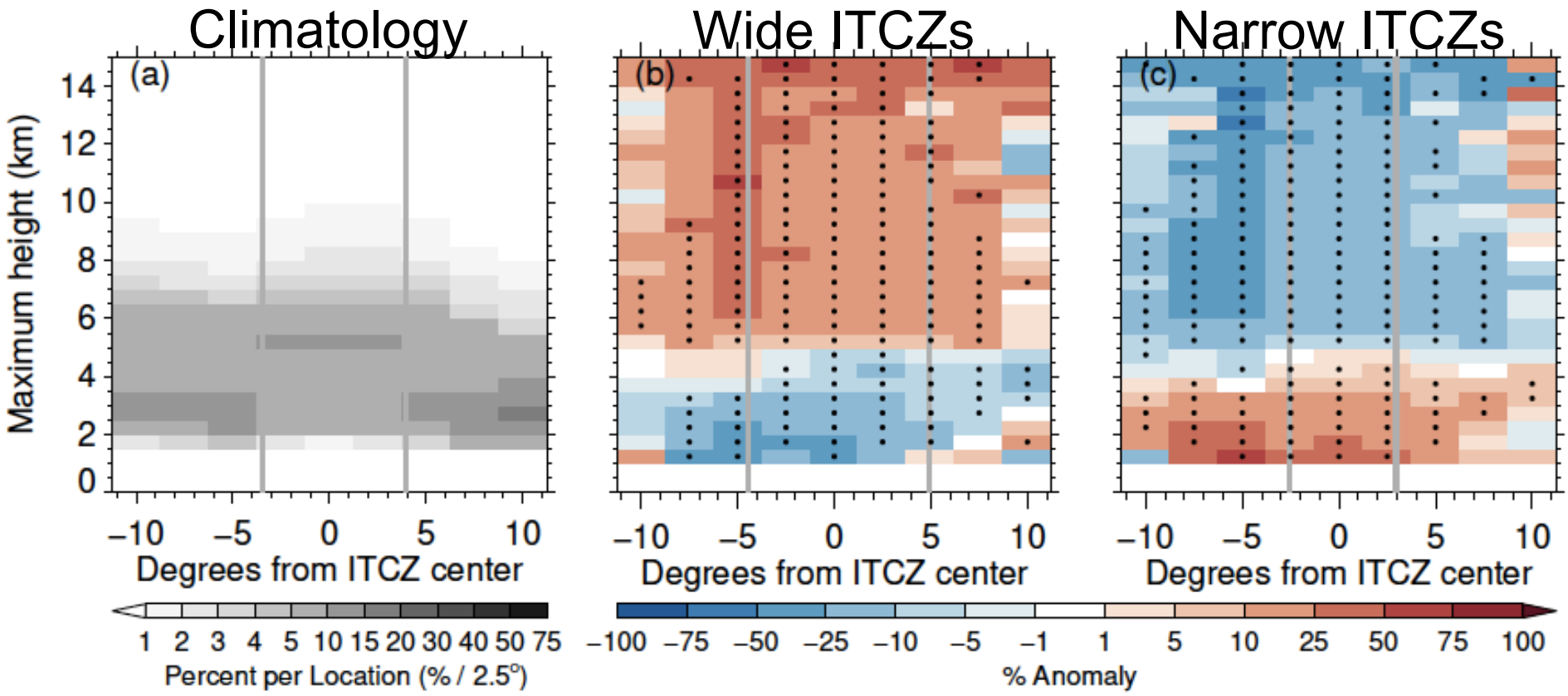


- **Composited distribution of PF anomalies for widest and narrowest 25% of ITCZ width distribution**

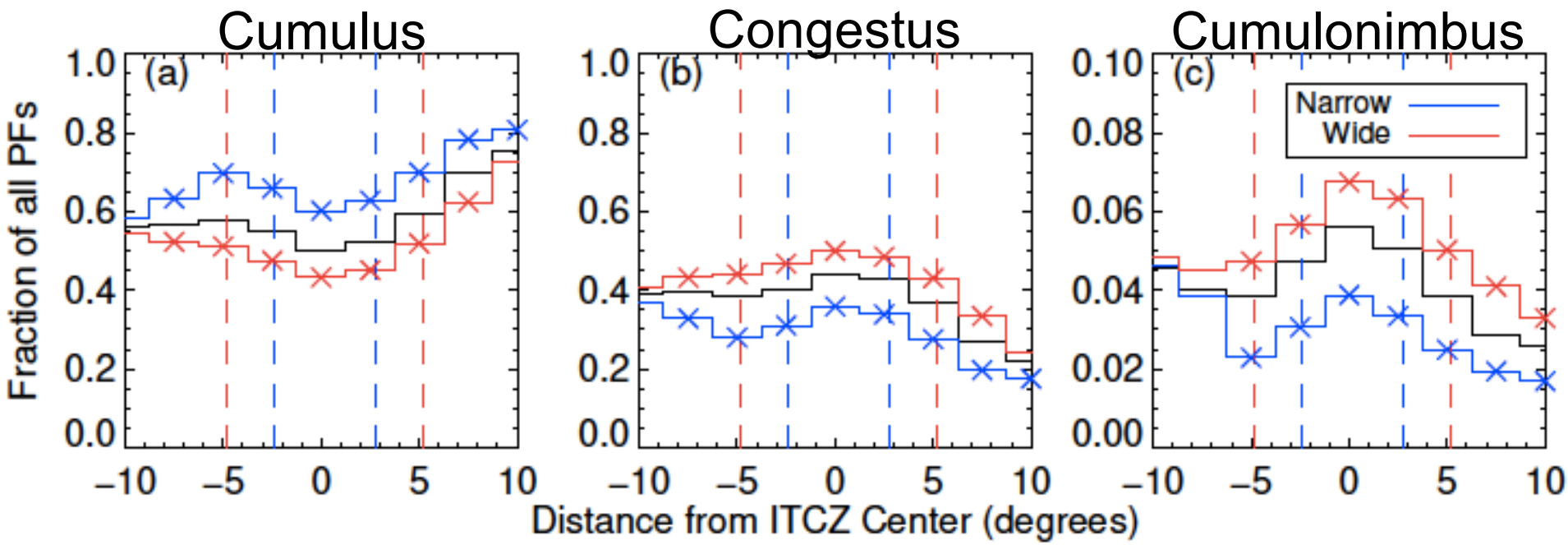


Liu et al. (2008)

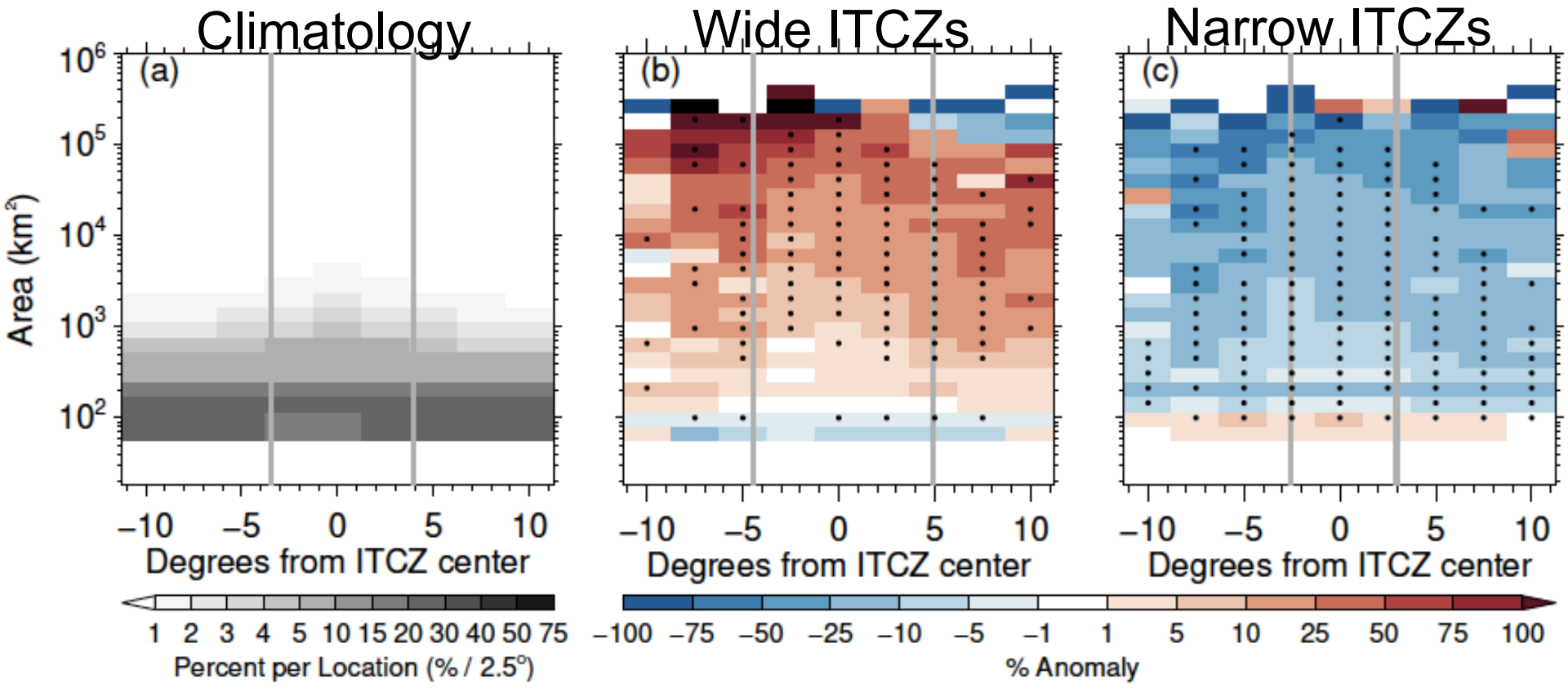
PF Maximum Height



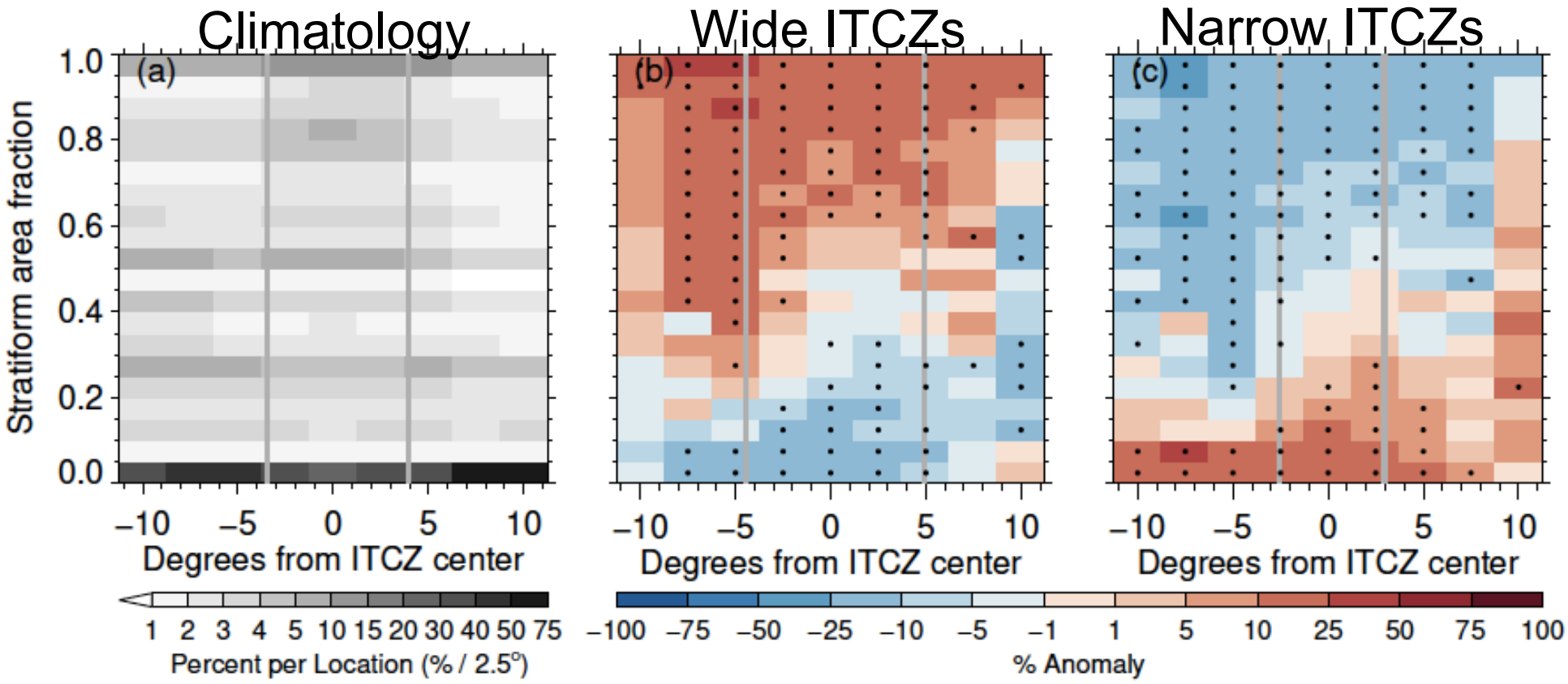
Wodzicki and Rapp (submitted)


Cumulus
Congestus
Cumulonimbus
(a)
(b)
(c)
Narrow
Wide
Fraction of all PFs
1.0
0.8
0.6
0.4
0.2
0.0
0.10
0.08
0.06
0.04
0.02
0.00
−10
−5
0
5
10
Distance from ITCZ Center (degrees)

PF Area


Climatology
Wide ITCZs
Narrow ITCZs
(a)
(b)
(c)
Area (km²)
10⁶
10⁵
10⁴
10³
10²
−10 −5 0 5 10
Degrees from ITCZ center
1 2 3 4 5 10 15 20 30 40 50 75
Percent per Location (% / 2.5°)
−100 −75 −50 −25 −10 −5 −1 1 5 10 25 50 75 100
% Anomaly

PF Stratiform Area



Summary

- **When ITCZ is wide:**
  - PFs deeper and larger, with greater stratiform area
- **When ITCZ is narrow:**
  - PFs smaller and shallow

Future work

- **Build a cloud feature dataset with VIRS, TMI, and PR to examine precipitation-anvil cloud area relationships change with environment, ENSO, large-scale ITCZ state?**